485. Proposed by NATHAN ALTSHILLER, University of Colorado.

Find the surface generated by the orthogonal projection of a given line upon a variable plane turning about a fixed axis.

CALCULUS.

403. Proposed by C. N. SCHMALL, New York City.

A paraboloid of revolution generated by the curve $x^2 = 4ay$, contains a quantity of water such that if a sphere of radius r be dropped to the bottom, it will just be covered by the water. Show that if the volume of water used in this experiment is to be a *minimum*, then we must have $a = r/6$.

404. Proposed by B. J. BROWN, Victor, Colorado.

Solve the differential equation, $(x^2 - y^2)(1 + dy/dx) = 2xy(1 - dy/dx)$.

MECHANICS.

321. Proposed by E. J. MOULTON, Northwestern University.

The attraction, A, in any given direction, due to a homogeneous sphere, on a particle at the center of the sphere, using the Newtonian law, is obviously zero. Find the error in the following method of computing A. Take cylindrical coördinates with origin at the center of the sphere; let the z-axis extend in the direction of the attraction to be computed, and let r, θ be the polar coördinates used. Let δ be the density and R the radius of the sphere, and k the constant of gravitation. Then

$$A = \int_{z=-R}^{z=R} \int_{r=0}^{r=\sqrt{R^2-z^2}} \int_{\theta=0}^{\theta=2\pi} \frac{k\delta r z d\theta dr dz}{[r^2 + z]^{3/2}} \tag{1}$$

$$= 2\pi k\delta \int_{z=-R}^{z=R} \left[\frac{-z}{(r^2 + z^2)^{1/2}} \right]_{r=0}^{r=\sqrt{R^2-z^2}} dz \tag{2}$$

$$= 2\pi k\delta \int_{-R}^{R} \left[\frac{-z}{R} + 1 \right] dz \tag{3}$$

$$= 4\pi k\delta R. \tag{4}$$

322. Proposed by FRANK R. MORRIS, Glendale, Calif.

A pole of uniform size and weight throughout its length stands in a vertical position. The height of the pole is h and weight w. It hinges at the base and falls, passing through a horizontal position. At the moment it reaches the horizontal position, how far from the base is the maximum vertical force tending to break the pole? How great is this force? What is the horizontal force at the same position in the pole?

323. Proposed by CLIFFORD N. MILLS, Brookings, S. Dak.

Two equal bodies are placed on a rough inclined plane, being connected by a light inelastic string; if the coefficients of friction are respectively $\frac{1}{3}$ and $\frac{1}{4}$, show that they will both be on the point of motion when the inclination of the plane is $\sin^{-1}(7/25)$.

NUMBER THEORY.

239. Proposed by HAROLD T. DAVIS, Colorado Springs, Colorado.

Give a general method for determining the solution in integers of the equation

$$x^r - 10xy - (n + 1) + y = 0,$$

where r and n are positive integers.

240. Proposed by J. W. NICHOLSON, Louisiana State University.

If the roots of $x^3 - px + q = 0$ are rational, prove that $4p - 3x^2$ is a perfect square.